Informational Leaflet 63

KING SALMON (Oncorhynchus tshawytscha) SPAWNING GROUND SURVEYS IN THE BEHM CANAL AREA OF SOUTHEASTERN ALASKA

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KING SALMON (ONCORHYNCHUS TSHAWYTSCHA) SPAWNING GROUND SURVEYS IN THE BEHM CANAL AREA OF SOUTHEASTERN ALASKA.[1]

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INTRODUCTION

In contrast to the larger king salmon (Oncorhynchus tshawytscha) producing areas in the northern district of Southeastern Alaska (Taku, Alsek, and Stikine Rivers) where some information was available on catch, escapement and spawning ground locations, the size of the runs and locations of the spawning grounds were largely unknown in the southern or Ketchikan District. To obtain information of the king salmon stocks in this area a field survey crew covered the larger reported king rivers in this district throughout the summer of 1961. The area surveyed comprised all of the larger mainland streams in the Behm Canal area. The surveyed rivers are reported as separate spawning units.

[1]This investigation was conducted with Federal Aid in Fish Restoration Funds under Project F-5-R-3 (1961-1962).

[2]Mr. Anthony is now employed by the U.S. Bureau of Commercial Fisheries, Boothbay Harbor, Maine.

PROCEDURE

The river surveys were made by means of a 24-foot river boat with outboard and lift, float plane, helicopter (shared program with the Branch of River Basin Studies, Fish and Wildlife Service) and by foot parties. One or more of these methods were used in any one survey, depending on the terrain, but the greatest effort was provided by a river boat and foot party combination. When possible the extent and location of spawning grounds, as well as the numbers of fish, were obtained for the king salmon streams surveyed. Detailed maps were drawn of the unknown spawning systems when they were not available from other sources.

FINDINGS

Unuk River (Behm Canal)

The Unuk River, reported to be the largest king producing river in the Ketchikan area, enters Burroughs Bay (Behm Canal) 53 miles north-northeast of Ketchikan, Alaska. It is an extremely turbid river, roughly 80 miles long, and drains an estimated 1500-square-mile watershed. Most of its watershed is in a glacial mountainous region in British Columbia and only the lower 24 miles of the river are in Alaska. The lower valley is broad and flat with extensive flood plains, steep valley walls, and tributaries of glacial origin. The river on the United States side is constricted at one point by a lava flow that has formed a narrow gorge known as the First Canyon. The Second Canyon lies just above the border in British Columbia. Boating is extremely hazardous in portions of this canyon except at periods of very low water. Between these canyons the valley floor consists mainly of gravel bars that change position with each high water (see Figure 1). Below First Canyon, log jams are constantly being formed and are a hindrance to navigation.

In the summer of 1961 a king salmon spawning ground survey was conducted during three periods; from July 11 through July 17, July 27 through July 30 and August 22 through August 27. Mr. Art Matney, who formerly lived at the river mouth, was hired as a guide during the first period. Two aerial surveys by airplane and helicopter were made on July 5 and August 17, respectively. A 24-foot aluminum riverboat powered by a 40 h.p. motor on a Yukon lift was used throughout the survey. A foot survey was made when navigation was not possible. All five species of Pacific salmon (Oncorhynchus) were counted and scale samples and length measurements of king salmon were collected when possible.

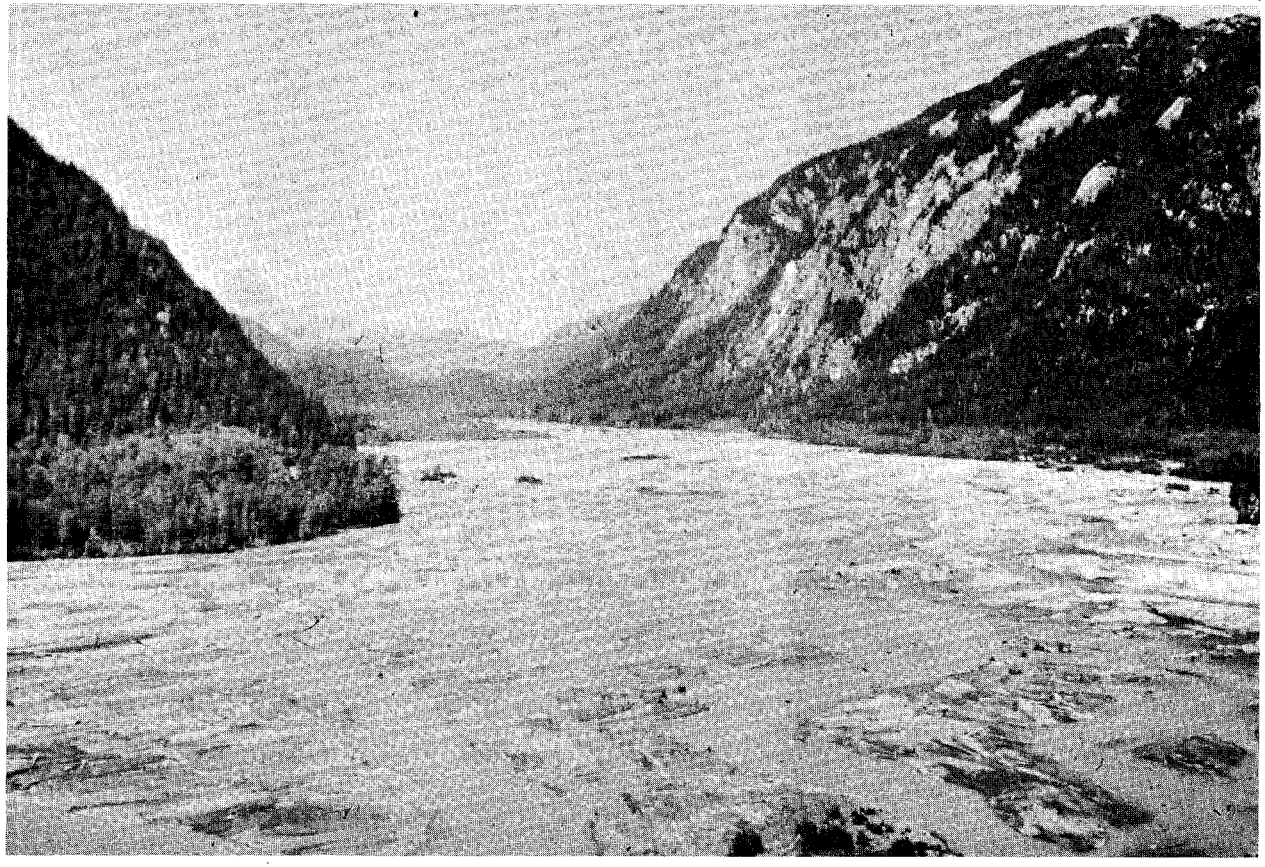


Figure 1. Unuk River between First and Second Canyons shifting gravel bars and channels.

The Unuk River survey includes all streams from the Eulachon (Hulakon, Ooligan) River at the Unuk mouth to the Second Canyon in British Columbia (Figure 2 - Sections 1 through 5). Streams above this point were surveyed by helicopter by Robert McVey (Branch of River Basin Studies, Fish & Wildlife Service) and Gary Finger (Alaska Department of Fish and Game) in a joint effort. Their observations are also included in this report.

The accuracy of the fish counts was influenced by several factors. High glacial water and bear predation reduced the count in some areas. The summer of 1961 was unusually dry and warm with the result that little rain water and much glacial melt rendered the streams more turbid than normal. Many streams were also very similar in their spawning times and the simultaneous rapidity of entrance, spawning and egress made the timing of the surveys difficult.

Several smaller creeks had high resident bear populations which removed a large percentage of the fish. Twelve bears, two black (Ursus americanus) and ten brown, (Ursus arctos) were seen in the Unuk system, primarily in the Clear Creek system (Lake Creek). Such circumstances involved with each stream are included in the individual stream descriptions given below. Fish counts and dates are given at the end of the Burroughs Bay section in Table 2. (pages 26 and 27)

Eulachon River

Eulachon River enters the Unuk at its mouth on the northwest shore. It averages 50 feet in width and splits into two branches at a point 3-1/2 miles upstream. The west branch is the longest, extending for 6 miles, but is blocked by a 400-yard section of steep cascades 3/4 mile above its junction with the east branch. The east branch is 3 miles long with a 6-foot falls at mile 2 that completely blocks chum salmon (O. keta) and pink salmon (O. gorbuscha) migrations. Excellent gravel is present for a short way above this falls and 8 king salmon were seen in the lower 3/4 mile above the falls on August 1. The upper portions of the system contain fine spawning gravel although stretches of sand connect the riffle areas. The lower two miles of the Eulachon has a sandy substrate. Four different surveys were made of this system. It can be seen from Table 1 that the peak of migration occurs during the latter part of July. Chum salmon spawn during the first part of August while the pink and king salmon reach their spawning peak a week or two later. Coho salmon (O. kisutch) enter the system in early September.

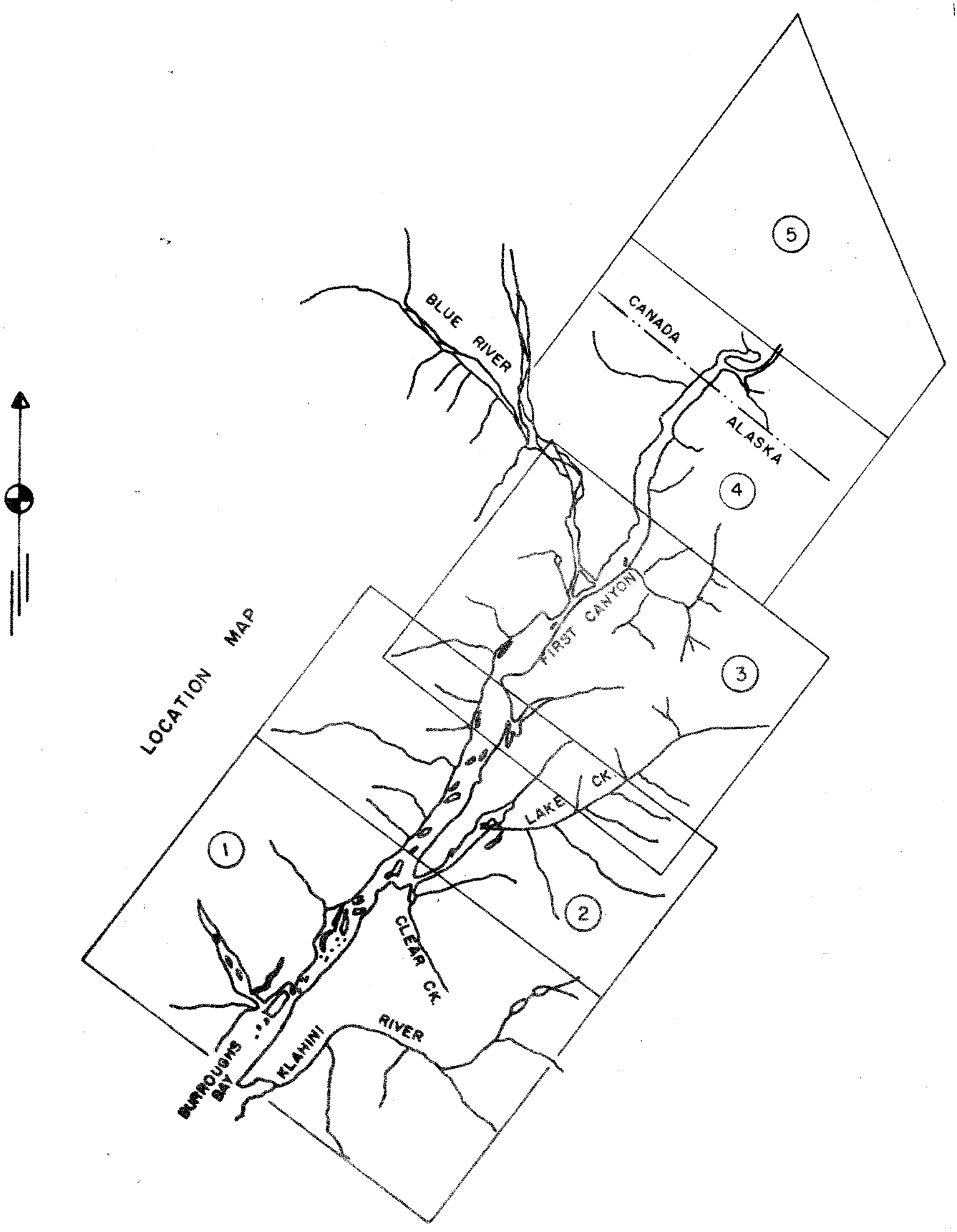
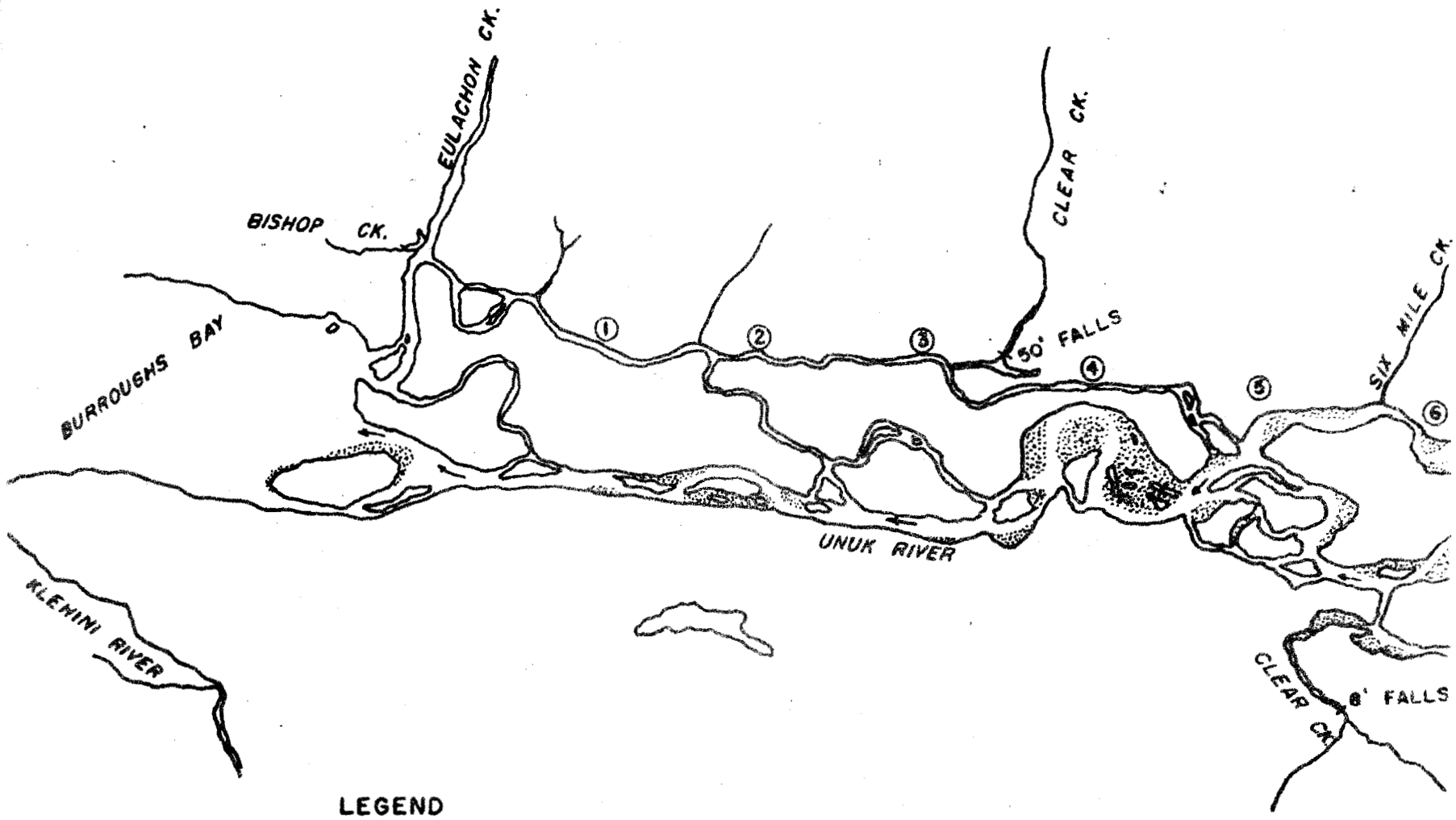


Figure 2. The Unuk River watershed showing the principal king salmon spawning areas.



LEGEND

SHADED PORTIONS OF RIVER BED SHOW LOCATION OF GRAVEL BARS AT LOW WATER

ARROWS INDICATE BEST PRESENT BOAT ROUTE

MILE POST SHOWN THUS: ⓪

Figure 2. Section 1. Lower Unuk River.

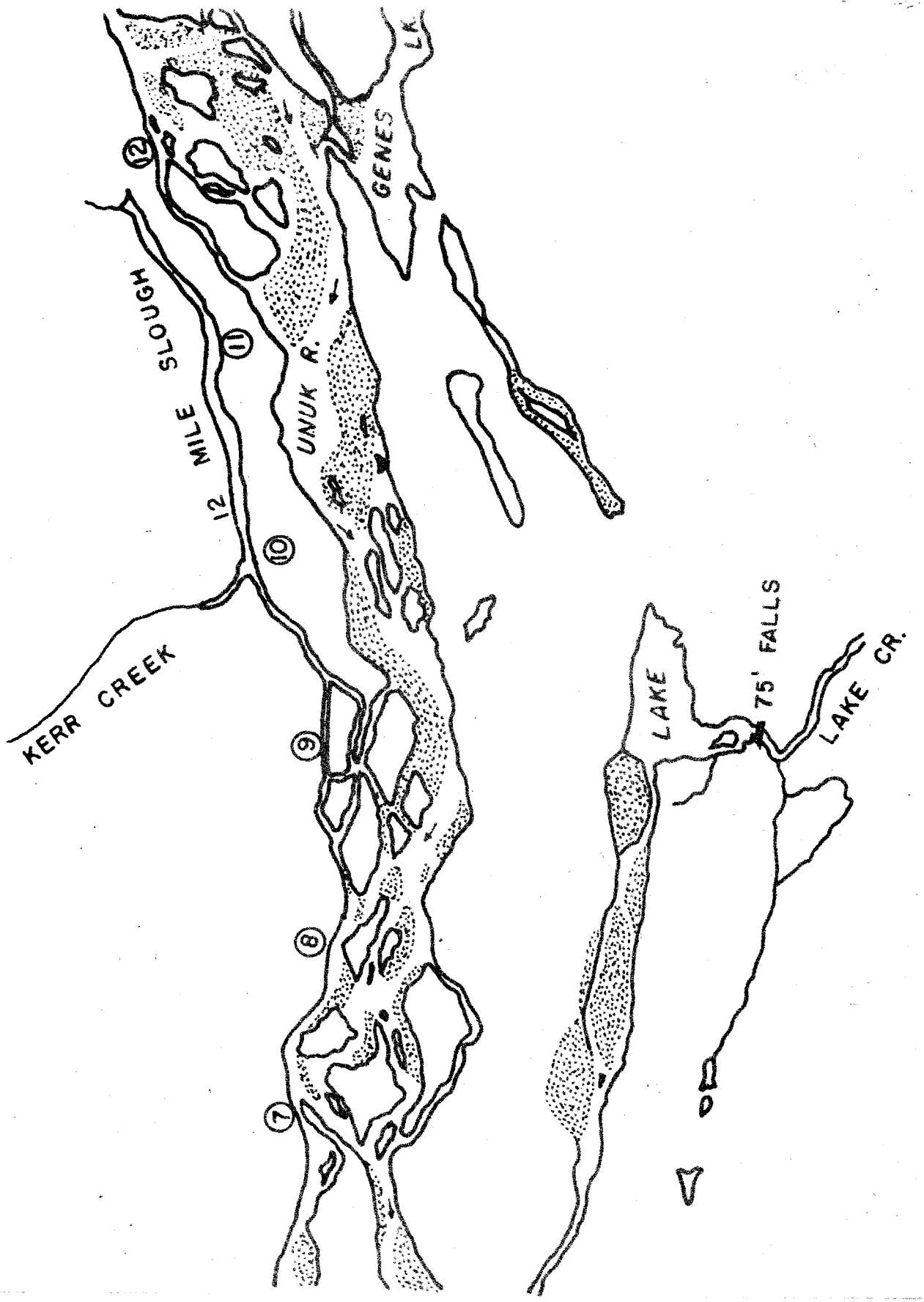


Figure 2. Section 2. Lake Creek section.

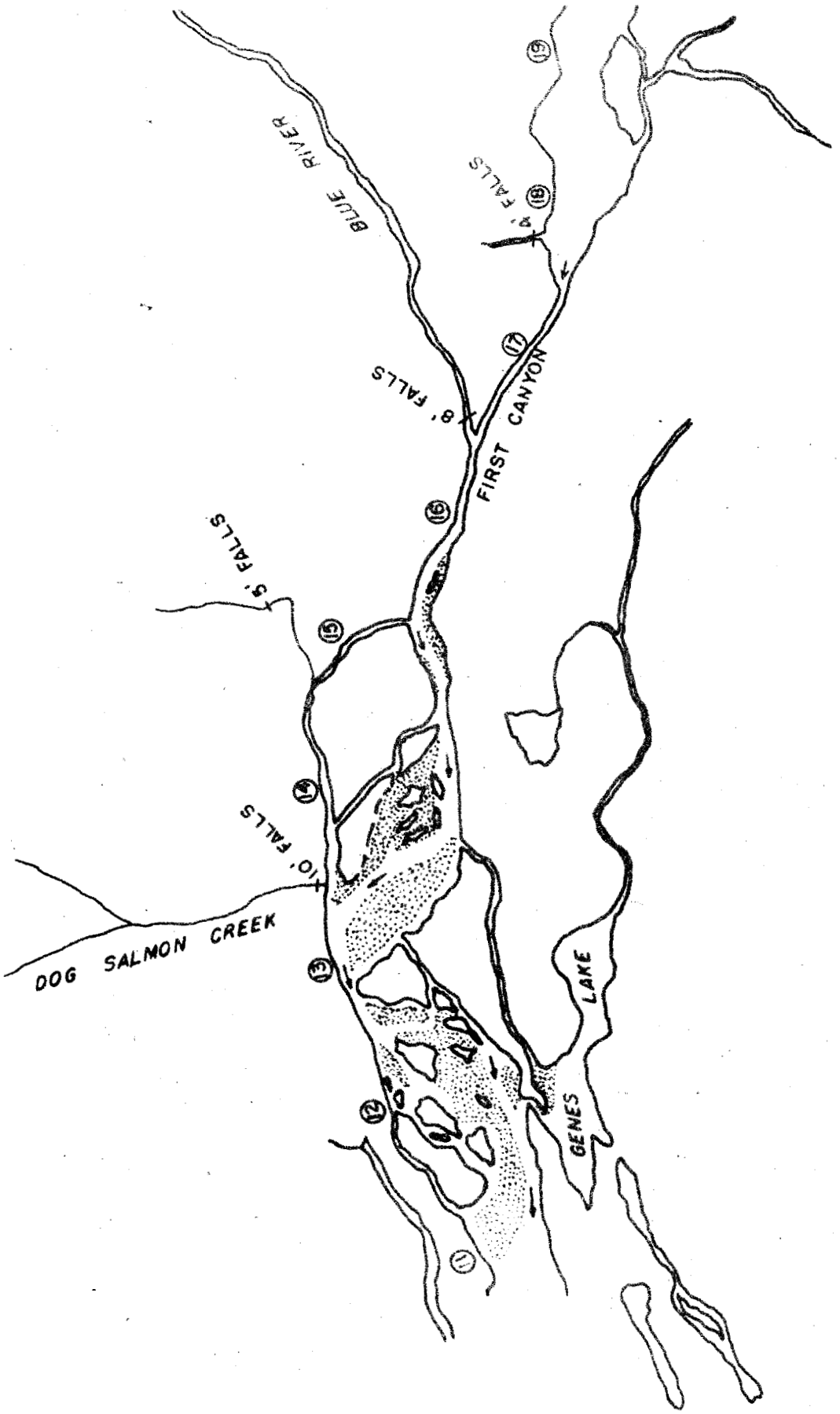


Figure 2. Section 3. Genes Lake - Blue River section.

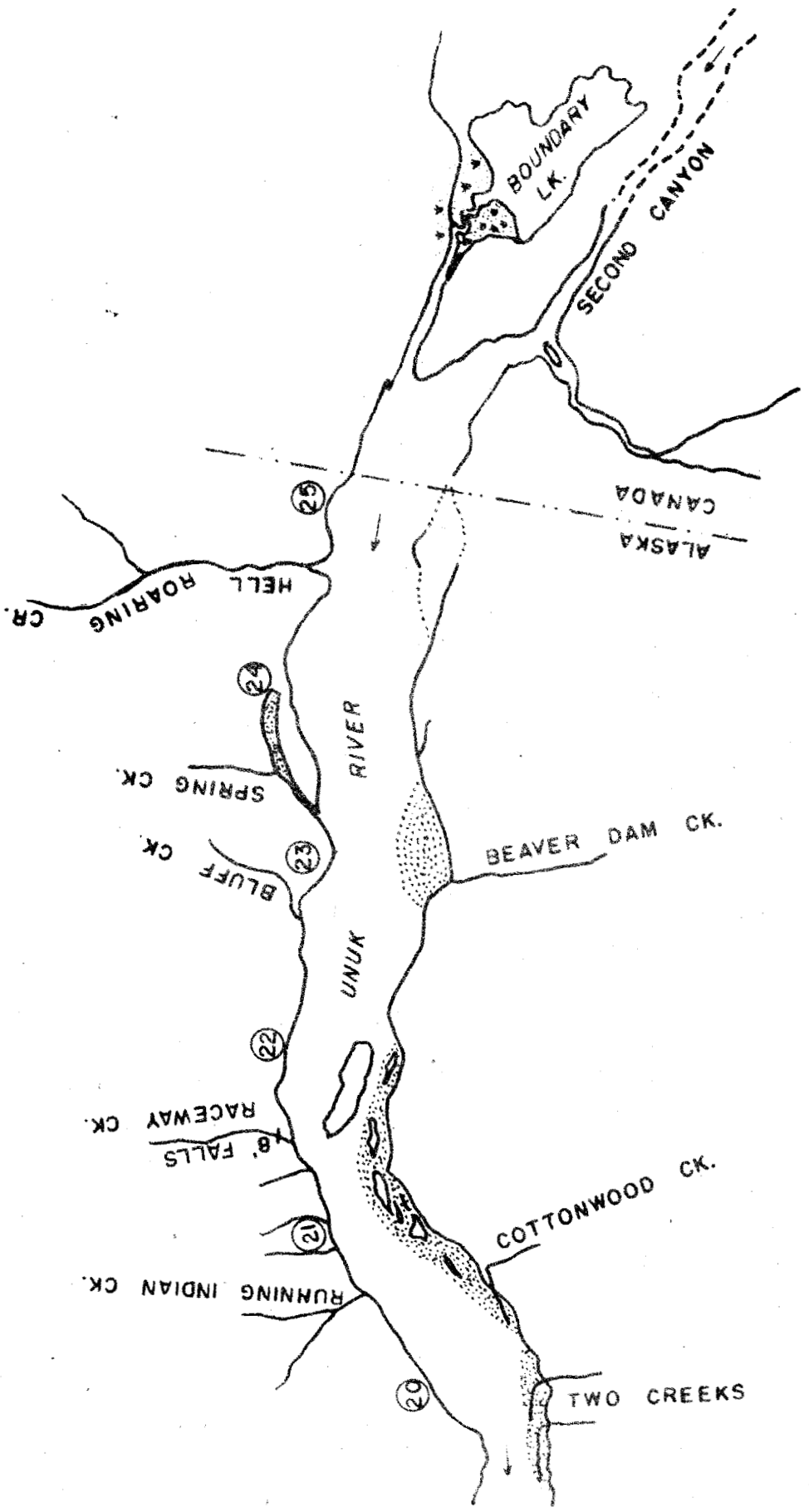


Figure 2. Section 4. Boundary Lake section.

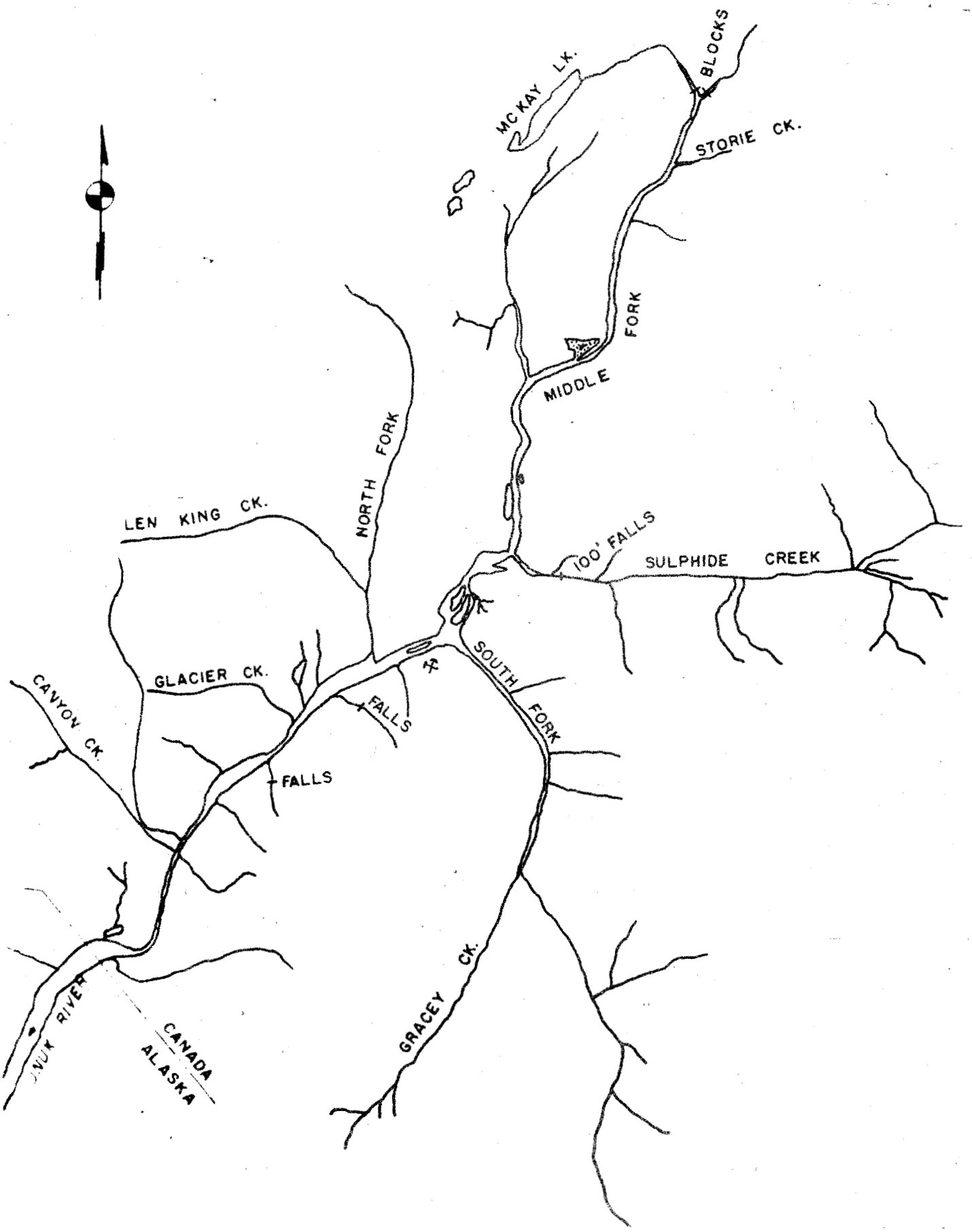


Figure 2. Section 5. Upper Unuk River.

A small tributary known as Bishops Creek runs into the Eulachon on the south shore about 100 yards from the Eulachon mouth. It contains about 75 yards of suitable spawning area averaging 20 feet in width. On August 1, 136 pink and chum salmon were noted here.

The following streams enter the Unuk River on the northwest shore. Their location is given in miles from the Unuk River mouth.

Clear Creek (West Shore)

This mountain stream empties into a Unuk slough which also receives waters of Eulachon Creek three miles downstream. About 400 yards of the river averaging 30 feet in width are used for spawning. A series of 5 adjoiming falls totaling 50 feet in height stops all migration at the head of this section. A large pool (50 by 25 yards) below the falls contains numerous large boulders and is not utilized for spawning purposes. Below the pool the clear water of the stream blends with the Unuk water on the spawning beds. The gravel was loosely mixed with sand throughout, a characteristic of most of the lower tributaries of the Unuk River. Redds were well defined and many dead chums and live pinks were seen, indicating that the spawning peak had passed for chum salmon at the time of the survey.

Six Mile Creek

This is another mountain stream with a steep gradient that meets the Unuk at mile six. A plane survey on July 5 and a helicopter survey on August 17 revealed no signs of fish and only a limited spawning area was observed. The foot survey was abandoned on August 23 due to excessively high water.

Kerr Creek

This is a glacial stream and at the time of survey was bluish green with a visability of less than one foot. It was formerly reported to enter an old slough of the Unuk (Twelve Mile Slough) at mile ten. The flow for this slough has altered its path or ceased to exist as no slough was seen during the foot or helicopter survey; what appeared to have once been its channel was quite dry and overgrown with brush. The stream splits as it flows off the hillside, forming a 15-foot and 9-foot falls. Intermittent spawning gravel was observed below these falls for one-half mile. Much of the substrate consisted of sand or small gravel less than an inch in diameter. Occasionally gravel of a larger size was found and this was usually occupied by king salmon, although the available areas were not completely utilized.

Dog Salmon Creek

This is a clear stream, 25 feet wide, containing about 75 yards of poor spawning rubble below a 10-foot falls. It enters Sawmill Slough at its entrance to the Unuk at mile 13-1/2. The stream bed is very rocky, consisting of boulders up to several feet in diameter throughout the area. Two chum salmon and two cutthroat trout (Salmo clarkii) were the only fish seen in the system.

Sawmill Creek

This slough enters the main Unuk at mile 13-1/2. The lower mile of the slough contains glacial Unuk water and apparently has a silty substrate. Clear water extends for 3/4 mile at the upper end of the slough and this was the only location where fish were observed during the surveys. Seventy-five percent of the stream bottom in the clear water consisted of watermoss resembling Fontinalis, sand (lower end especially) and what appeared to be sawmill waste. The stream in the upper 100 to 150 yards was only 15-20 feet wide and divided into 3 small brooks that joined before entering the slough proper. This upper section contained spawning gravel of good size, although it was compacted in some spots. The width of the slough below this point averaged 60 feet. The depth varied from a foot or less to 15-20 feet to the bottom of several deep springs. The fish for the most part occupied the upper section and the pool joining the slough proper. A falls only four feet high appeared to be a total block to migration because of shallow water below the falls. The subsurface of this area is almost entirely lava rock. Only one or two bears were observed but the fish were very vulnerable to predation in the upper reaches.

Blue River

This large tributary of the Unuk flows southeast for about 12 miles and cascades over a 6-foot falls into the First Canyon near its lower end (see Figure 3). A recent lava flow from the mountainous region northwest of First Canyon traveled southeast across the valley to a high mountain wall and completely blocked the river. The Unuk gradually cut through the lava deposit against the mountain wall to form a long, narrow gorge. The Blue River then eroded through the center of the lava flow and joined the Unuk. The river ranges up to 300 feet wide and, 6 miles upstream from the Unuk, forms a small lake above a branch in the system called Lava Fork. The light blue color of the water may be due to materials in the water dissolved from the lava deposit. The river was surveyed twice from the air and once by foot, but no fish were observed in the system.

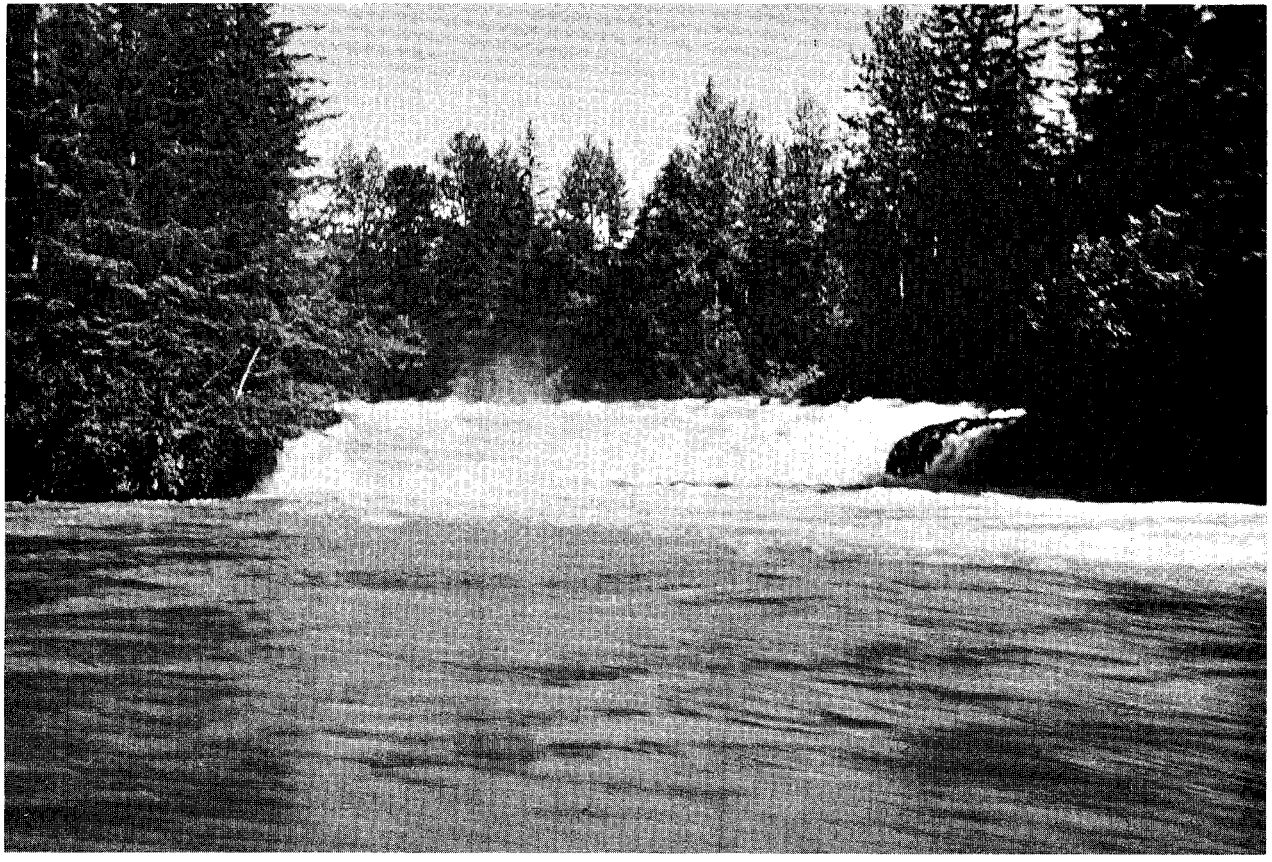


Figure 3. Blue River entrance into the Unuk River at First Canyon.

Although the falls where the river enters First Canyon appears passable, two more falls about a mile upstream may block further migration. The biggest deterrent for the use of this tributary for salmon spawning is probably the lack of suitable gravel.

Little Blue River

This river arises in the lava fields north of the Blue River and flows an undetermined distance to enter the Unuk at the upstream side of First Canyon. It probably is a seepage stream as many small freshets were noted issuing from the lava walls of First Canyon throughout its length. The spawning area is confined to a single large pool, 200 yards long and averaging 80 feet wide. Its depth ranges to 15 feet in what appeared to be a spring. Spawning was confined to a few shallow shore areas where excellent spawning gravels were available among the lava rock. Red salmon (O. nerka) were seen spawning here on August 24. These may be what are termed "creek" sockeye, i.e., those spawning in creeks with no lake system. The head of the pool is blocked by several small falls three to four feet high. The second falls is constricted between and under several large pieces of lava rock.

Raceway Creek

This creek enters the Unuk at mile 21-1/2. For most of the 300 yards below a series of high falls, the spawning channel is composed of excellent spawning gravel. Only the last 40 yards upstream contain some sand and larger rocks. The lower section is 15 to 20 feet wide and 6 to 10 feet deep with constant gravel size throughout. The water is crystal clear and seems to have little fluctuation. The section is so straight with a level bottom that it resembles an artificial raceway. It was very surprising to find no fish spawning in this area on either of the two foot surveys.

Bluff Creek

This stream is located at mile 23 between two low bluffs. It is a small creek, perhaps 15 feet wide and less than a foot deep which joins a side slough of the Unuk. Together they flow along a gravel bar for about 300 yards before entering a large slough of the main river. The water is quite glacial, although noticeably lighter in color than the main Unuk. Fourteen dead chum salmon were counted on August 25 in this section which averages 50 feet in width.

Spring Creek

At mile 24 a small flow of water, from about 8 to 10 springs located in a clump of cottonwoods, joins a small mountain stream and travels several hundred yards to the main Unuk. The length of the entire system is about 1/4 mile and is about 15 feet wide. Silt was present in some places over the gravel. No old redds were noted here, but several thousand coho fingerlings were present.

Boundary Lake

Boundary Lake, at mile 27 in Canada, apparently derives its water from large springs in several coves on the northern shore. The lake is only about 40 acres in size and is rapidly undergoing eutrophication (see Figure 4). This ecological succession is especially pronounced along the south and east shore. The lake outlet and 1/2 mile of littoral zone on the south shore were so choked with sedges and Potamogeton at the time of our surveys that there was no clear channel into the lake. A survey conducted by the Branch of River Basins of the Fish and Wildlife Service just three years previously noted that the lake outlet "... possesses excellent gravels and riffle-pool development and contains several excellent pools with depth exceeding five feet. The water was relatively clear at the time of our survey ...."[1] At the time of our surveys the outlet contained so much aquatic vegetation that only a few narrow channels of a few yards in length were left for spawning purposes and the water was murky during both surveys, however, two king salmon were seen in these areas. The lake water at the north end of the lake was quite clear and red salmon were observed spawning in one of the coves on this shore. On July 15, 20 to 30 reds moved into a cove and by August 25, several hundred were using the cove with over 3/4 of them still alive.

Canyon Creek

This is the only inlet to Boundary Lake but affects little, if any, the lake level as it disperses itself throughout the marshy area near the outlet. This creek is over 6 miles long, 5 to 10 feet wide and has mainly a sandy substrate in the lower mile. It is extremely doubtful whether fish can migrate through the marshy area to reach the main stream flow.

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[1] U.S.F.W.S., Progress Report on the Fish and Wildlife Resources of the Iskut and Unuk River Basins. p. 17. April, 1959.

Figure 4. Boundary Lake showing modification of spawning grounds by succession of plant life.

Glacier Creek

This turbid stream has a steep gradient and a rocky substrate with no spawning facilities. It enters the Unuk at mile 41. Four cutthroat fingerlings were the only fish seen in a 1-1/2 mile foot survey. A helicopter survey by Gary Finger and Robert McVey for several miles up the valley revealed no decrease in the gradient and they did not observe any signs of fish.

Pearly Lake

This lake lies within 1/4 mile to the north of Glacier Creek. It has a small, muddy outlet that appears to make the lake inaccessible to salmon and a still smaller inlet. No fish were seen in the outlet, inlet or the clear water lake during a low altitude helicopter check on August 17.

The following survey information of the upper Unuk is supplied by Robert McVey of the U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Branch of River Basin Studies. These observations were made by him and Gary Finger of the Alaska Department of Fish and Game during a helicopter survey conducted on August 17.

No fish or carcasses were seen anywhere above Second Canyon. Excessive glacial turbidity, steep gradient and several falls reduced the spawning area in this upstream section to only a few short, clear stream sections which gave no sign of supporting salmon spawning. The tributaries are described individually below.

North Fork (Harrymel Creek)

This glacial creek is about 16 miles long and reaches the Unuk at mile 45. It has a very steep gradient and is very narrow.

Len King Creek

Len King Creek joins the north fork two miles from the Unuk River. It is about 10 miles long and is also a glacial stream with a fairly steep gradient. This is regarded by Robert McVey as the most likely king salmon stream above the Second Canyon.

Unnamed Creek

This creek enters the Unuk River at mile 56. It has a very steep gradient and is turbid above two miles. The creek flow apparently becomes subsurface in the lower reaches during low flow periods. A dry channel was noted in this area.

Outlet Stream from Tom Mackay Lake

Tom Mackay Lake, 5-1/2 miles northwest of the Unuk, enters the Unuk at mile 74, almost at the upper end of the Unuk River. The stream is very turbid and obstructed by a low falls near its confluence with the Unuk.

Upper Main Stem Unuk and Other Small Tributaries

The main Unuk is very turbid with a steep gradient and no visible spawning area. It is obstructed by a falls section just upstream from its confluence with Mackay Lake outlet.

Numerous small tributaries were checked between Second Canyon and the confluence of the North Fork and South Fork of the Unuk. Only one was sufficiently clear and of such a nature that it might be used by spawning fish. This was only a very short section of rather steep gradient, up to an impassable falls. A careful check revealed no sign of any fish.

Several short clear sloughs above the South Fork were noted. These were carefully checked but no fish were seen. Twelve beaver dams were seen in these areas, mostly upstream from Sulphide Creek.

The remaining twelve streams enter the Unuk River on the southeast bank. Their location, as before, will be given in miles up from the Unuk mouth.

Storie Creek

This is a clear stream which enters the Unuk at mile 69. It is a small creek with a steep gradient.

Sulphide (Sulphurite Creek)

This major tributary is about 24 miles long and enters the Unuk at mile 52. It is a very turbid stream and blocked to fish migration

by a 100-foot section of falls at its confluence with the Unuk.

South Fork (including Gracey, Granite and Devil Bliss Creeks)

This stream, another major upstream tributary, is about 28 miles long entering the Unuk at mile 47. The entire system is also very turbid except for a few snow-fed rivulets on the northwest shore of the South Fork. These were carefully checked but again no fish were seen.

The following streams were surveyed by riverboat, and enter the Unuk on the southeast shore.

Boulder Creek

Immediately below Second Canyon, Boulder Creek is formed from the glacial melt flowing out of two short canyons which join and cascade about a mile until reaching the Unuk. Its steep gradient, and bottom composed of large boulders, suggest it has little value as a spawning area. Several cutthroat fingerlings were found in shallow pools, however.

Short Creek

This stream and the next four are all clear mountain streams which drop almost straight down off the mountain side, in some cases several thousand feet. The only spawning area available is found along the gravel bars of the valley floor through which the streams flow to reach the Unuk. In all four streams the only salmon block is the steep gradient encountered at the hillside. The gravel is 1/2 to 2 inches in size and partially mixed with sand.

Short Creek is about 30 feet wide and flows for only 30 yards across a gravel bar to the Unuk at mile 24. Nine dead chum salmon were observed.

Beaver Dam Creek

This creek flows out of a steep mountain draw and joins a small slough of the Unuk in a group of cottonwoods and travels 1/4 mile to join the main Unuk at mile 23. Both surveys of this area were masked by high Unuk water which flooded the cottonwoods and enveloped the spawning channel. No fish other than coho fingerlings were seen and the length of the actual spawning channel could not be determined.

A small beaver dam had been started here at one time and then apparently abandoned.

Cottonwood Creek

This creek enters the Unuk at mile 20-1/2 after falling off the mountain into the edge of a group of cottonwoods and cutting its way for 400 yards through a gravel bar. It averages about 20 feet in width. Seventy-six chum salmon and two pink salmon were noted spawning in this small area.

Two Creeks

These two creeks reach the valley floor about 1/4 mile apart and flow a parallel course for another 1/4 mile to reach the Unuk at mile 20. Both the upper and lower creeks average about 40 feet in width. On August 24, 37 chum salmon were noted in the upper creek and 143 were counted in the lower creek.

Dickens Place Creek (Cripple Creek)

This creek enters the Unuk through a large delta just north of the first canyon. A small slough of the Unuk cuts behind the delta and mixes with the stream 300 to 400 yards from the main Unuk. Spawning appears heaviest below this point. Here the flow forms a spawning channel over 50 feet wide containing some excellent spawning gravel.

This tributary was very glacial during all four surveys attempted. On July 29 it was also excessively high and salmon were seen splashing many times but no count could be made. On August 24, however, we were able to count salmon carcasses on the banks and in the shallow riffles. In the first hundred yards of the main creek (above the Unuk slough) spawning seemed to be scattered due to a lack of gravel of suitable size. Above this section for about the next 1/8 mile no spawning area seemed to be present because of several deep pools. The upper reaches of the stream increased in gradient and produced some fine spawning areas. They were little utilized however. The gravel gradually increased to small boulders at 1-1/2 miles. No blocks were present. Bear predation was very heavy in the lower 1/4 mile.

Genes Creek

This creek enters Genes Lake (about 240 acres) which empties into

the Unuk at mile 12. On July 14, dark kings were seen scattered at the lake surface throughout the glacial tinged lake. The lake apparently holds king salmon throughout the month of July at which time the fish enter Genes Creek to spawn. The creek itself is over 5 miles long but increases in gradient beyond 3 miles. Our longest survey (2-1/2 miles) indicated that salmon do not utilize the creek to this point. The creek contains clear water and fine spawning gravel throughout the area surveyed. It averages 40 feet in width at the mouth but gradually decreases to 20 feet after the first half mile. Many red salmon were present. It was second only to the Eulachon River in numbers of king salmon present. On August 23, two schools of fish consisting of 125 red salmon and 50 king salmon were gathered at the mouth of the stream in two deep pools. Genes Lake may be a delaying factor in the movement of salmon into the creek. In no other surveyed stream did the fish wait so long before entering the stream.

Bear predation was very heavy on this stream. Carcasses were piled up by the bears on almost every gravel bar. On July 29, 30-40 king salmon were seen for a mile or more up the creek and few bears were present at this time. Although many fish later ascended the stream, the greatest majority of fish still alive were found in the deeper pools at the time of the last survey.

Lake Creek

This glacial creek is 20 miles long and enters Johnson's slough of the Unuk at mile 6. It is blocked by a 40 to 60-foot falls 3 miles upstream from the slough (see Figure 5). This prevents salmon from reaching approximately nine miles of reportedly fine spawning territory. One-half mile below the falls, the creek forms a small lake, of about 80 acres. The entire spawning area in the system is found between the lake and the falls. Below the lake salmon spawning must be extremely limited due to a sandy and fine gravel substrate. No spawning fish were seen in this area during any of the surveys.

A large, shallow pool about 100 feet wide immediately below the falls contained the only fish seen during the surveys. Gravel size here was very small, averaging less than an inch throughout the area.

Clear Creek (Lake Creek System)

Clear Creek enters the south shore of Lake Creek about 400 yards from Johnson's Slough. The creek averages 40 feet in width and is over 6 miles long but is blocked by a 7-foot falls and steep gradient 3/4 mile from Lake Creek. This entire area is used by salmon except for the lower 50 yards. This tributary was very clear during all of

Figure 5. Impassable falls and spawning area in Lake Creek.

the surveys and possessed excellent spawning rubble throughout the spawning area. It is heavily utilized by salmon. Coho were the only species of salmon not seen in the system.

Heavy bear predation probably removes a large number of fish in this system. At least four to five bears have been seen fishing in this area.

Conclusion

Approximately 4,300 chum, 3,500 pink, 700 king and 875 red salmon were counted in the Unuk River system. This is necessarily a minimum estimate of the numbers present because of glacial turbidity, high water, etc. Of the 8,500 chum, pink and kings counted, 6,270 or 74 percent of these fish were found in the Eulachon River. The Eulachon River and Genes Creek appear to be the two most important producers of king salmon in the Unuk River system. Of the total king salmon seen, 470 fish or 70 percent were observed in these two streams; 230 kings were scattered thoughout five other tributaries with Sawmill Slough (80 kings), Clear Creek (Lake Creek system, 65 kings), and Kerr Creek (53) being the main contributors. The numerous tributaries in Canada seemed to hold little promise as spawning areas even if salmon would spawn in very turbid waters, because of the steep gradients involved. Tributaries reaching the lower Unuk are also of doubtful value as major spawning areas because of their short length and natural obstructions. It is unfortunate that the Blue River, the major long tributary to the lower Unuk River, has no apparent spawning gravel because of its sub-surface of lava rock. Spawning in the main stem of the Unuk is also doubtful although a possible location is the lower end of the First Canyon below the confluence of the Blue River.

It appears from the 1961 survey that the Unuk River is incapable of supporting any major commercial king salmon fishery and its value to sport fishermen as a major king salmon producer remains questionable.

Other Burroughs Bay Streams

Klahini River

The Klahini enters Burroughs Bay 2 miles south of the Unuk River. This stream arises from two small glaciers 15 miles from Burroughs Bay, and averages 100 feet in width. A 25-foot falls 3-3/10 miles up the river prevents all further migration.

Chum and pink salmon spawn in the low intertidal area in large numbers. Two miles upstream, the river splits into four or five very small channels, preventing further navigation. These channels continue for 1/4 mile before converging, and are heavily utilized by chum and pink salmon. Bear predation is very heavy here.

The river for the rest of the way to the falls contains many riffles and pools. The few king salmon that were seen, and scattered chum and pink salmon, were present in this area. No spawning was observed, however.

At the time of the second survey, July 31, 400 to 500 of the chum salmon had died, indicating an approach to the peak spawning time. No spawned out pink salmon were observed on this date.

Grant Creek

Grant Creek enters Burroughs Bay on the north shore 6 miles from the Unuk River. It is over 14 miles long, 80 feet wide and contains excellent spawning gravels which are found throughout the stream. It has a distinct pool-riffle development and is slightly glacial. Two 6-foot falls at mile 7 prevent further migration to chum and pink salmon. Coho fingerlings were found above this point. King salmon have never been reported above this barrier. Several miles of excellent riffle areas are found in the upstream areas. The salmon run in this stream was small although old survey reports list 30 to 50 thousand fish as its escapement magnitude.

Herman Creek

This small, clear creek enters Burroughs Bay at its junction to Behm Canal 10 miles from the Unuk mouth. It is less than 4 miles long and 30 feet wide. Steep gradient beyond 3 miles curtails migration. A few sandy areas are found in the system and the stream is highly utilized. Forty-five king salmon were counted in the stream.

The U. S. Fish and Wildlife Service maintained a weir 1/4 mile above the mouth of this stream from 1948 to 1956. The buildings at the weir site are still in excellent condition. King salmon counts are given in Table 1.

Table 1.

Year	Number of Kings	Year	Number of Kings
1942	0	1952	17
1943	0	1953	6
1947	0	1954	24
1948	0	1955	9
1949	9	1956	26
1950	4	1957	10
1951	17		

The 45 king salmon observed in 1961 almost doubles the previous high year of 1956. This is an exception to other streams of the study area which appear to have a run below those of previous years.

Chickamin River

The Chickamin River drains four large valleys and empties into Behm Canal 40 miles northeast of Ketchikan, Alaska. The three major branches that comprise the river drain an area 100 miles in length. Large glaciers at the head of all three branches supply the major water source of this river making it very turbid. Numerous small mountain streams throughout the watershed empty into the Chickamin but few of them are of any consequence to salmon. The Chickamin is 17 miles southeast of Burroughs Bay and, like the Unuk, reportedly contains spawning grounds for all five species of salmon as well as Dolly Varden char (Salvelinus malma) and cutthroat trout (Figure 6).

Mr. A. B. Wolf, who has resided at the mouth of the Chickamin for over 32 years, was extremely helpful and kind throughout the survey and provided much useful information on the entire river system. The survey was conducted from August 1 to 5 and August 27 to September 7.

A report of each tributary follows. Locations are given in miles from the Chickamin mouth and in relation to the main Chickamin branch. Fish counts and dates are given in Table 3 at the end of the Chichamin River section (page 34).

Clear Water Creek

This creek enters the mouth of the Chickamin on the north shore. It is 2 miles long, 15 feet wide and is reported to support only a run of coho salmon. A long series of small falls at the mouth of the stream cascade for over a mile. These appear to be a block to pink

TABLE 2. SALMON SURVEY DATA - RIVERS ENTERING BURROUGHS BAY
SUMMER 1961

River System	Date Surveyed	Distance Surveyed	Chums	Pinks	Kings	Reds	Cohos
Unuk River							
Eulachon R.	July 2	3-1/2 miles	3	-	-	-	-
	July 11	4-1/2 miles	47	10	1	-	-
	Aug. 1	5-1/2 miles	3000	3000	270	-	-
	Sept. 9	5-1/2 miles	30*	60*	24*	-	100
Clear Creek	July 13	3/4 mile	30	-	10	-	-
(Lake Cr. System)	July 27	" "	550	28	65	-	-
	Aug. 16	" "	No. cnt.	No cnt.	No cnt.	63	-
Lake Creek	July 13	3-1/2 miles	-**	-**	-**	-**	-
	July 27	" "	2**	-**	-**	-**	-
	Aug. 16	" "	1**	23**	-**	-**	-
Clear Creek (west shore)	Aug. 22	1/2 mile	150	300	-	-	-
Kerr Creek	Aug. 23	1 mile	3**	16**	53**	-**	-
Genes Creek	July 14	1/4 mile	-	-	75+ in lake	-	-
	July 17	1/4 mile	-	-	-	-	-
	July 29	1-1/2 miles	10	10	200	400	-
	Aug. 23	2-1/2 miles	1	4	165	540	-
Sawmill Slough	July 17	3/4 mile	15	-	10	-	-
	July 29	" "	80	45	80	13	-
	Aug. 26	" "	20**	7**	3**	2**	-
Cripple Creek	July 14	1/8 mile	-**	-**	-**	-**	-
	July 16	" "	-**	-**	-**	-**	-
	July 29	" "	many **	-**	-**	-**	-
	Aug. 24	1-1/2 miles	105**	12**	3**	-**	-
Dog Salmon Cr.	July 17	75 yards	-	-	-	-	-
	July 29	" "	2	-	-	-	-
	Aug. 26	" "	-**	-**	-**	-**	-
Little Blue River	July 14	1/8 mile	-	-	-	-	-
	July 16	" "	1	-	-	-	-
	July 29	" "	20	-	-	-	-
	Aug. 24	" "	75	-	-	5	-
Running Indian Creek	July 16	mouth only	NO SPAWNING AREA				
Raceway Creek	July 16	300 yds.	-	-	-	-	-
	Aug. 25	" "	-	-	-	-	-
Bluff Creek	Aug. 25	" "	14	-	-	-	-

TABLE 2. (Continued)

River System	Date Surveyed	Distance Surveyed	Chums	Pinks	Kings	Reds	Cohos
Spring Creek	July 16	1/4 mile	-	-	-	-	-
	Aug. 25	" "	-	-	-	-	-
Hell Roaring Creek	July 16	mouth only	NO SPAWNING AREA				
Canyon Creek	July 15	1 mile	-	-	-	-	-
Boundary Lake	July 14	entire system	-	-	2	150-200	-
	Aug. 25	" "	-	-	1	250	-
Boulder Creek	July 15	1-1/2 miles	-**	-**	-**	-**	-
	Aug. 25	mouth only	-**	-**	-**	-**	-
Short Creek	Aug. 25	30 yards	9	-	-	-	-
Beaver Dam Cr.	July 15	1/8 mile	-**	-**	-**	-**	-
	Aug. 25	" "	-**	-**	-**	-**	-
Cottonwood Cr.	Aug. 25	400 yards	76	2	-	-	-
Two Creeks							
Upper Creek	July 16	1/4 mile	-	-	-	-	-
	Aug. 24	" "	37	-	-	-	-
Lower Creek	July 16	1/4 mile	-	-	-	-	-
	Aug. 24	" "	143	-	-	-	-
Glacier Creek	Aug. 17	1-1/2 miles	-**	-**	-**	-**	-
Other Burroughs Bay Streams							
Klahini River	July 12	1 mile	50**	30**	1**	-**	-**
	July 31	3 miles	3000**	1000**	-**	-**	-**
	Aug. 17	3.3 miles	No. cnt.	1500**	15**	No cnt.	-**
Grant Creek	July 2	3 miles	-	-	-	-	-
	July 9	7 miles	1	-	-	-	-
	Sept. 10	6-1/2 miles	30	100	40	-	65
Herman Creek	Aug. 15	2 miles	3000	400	-	-	-
	Aug. 21	2-1/2 miles	-	-	45	1	-

* Alive Only

** Water high or glacial; count valid but probably incomplete

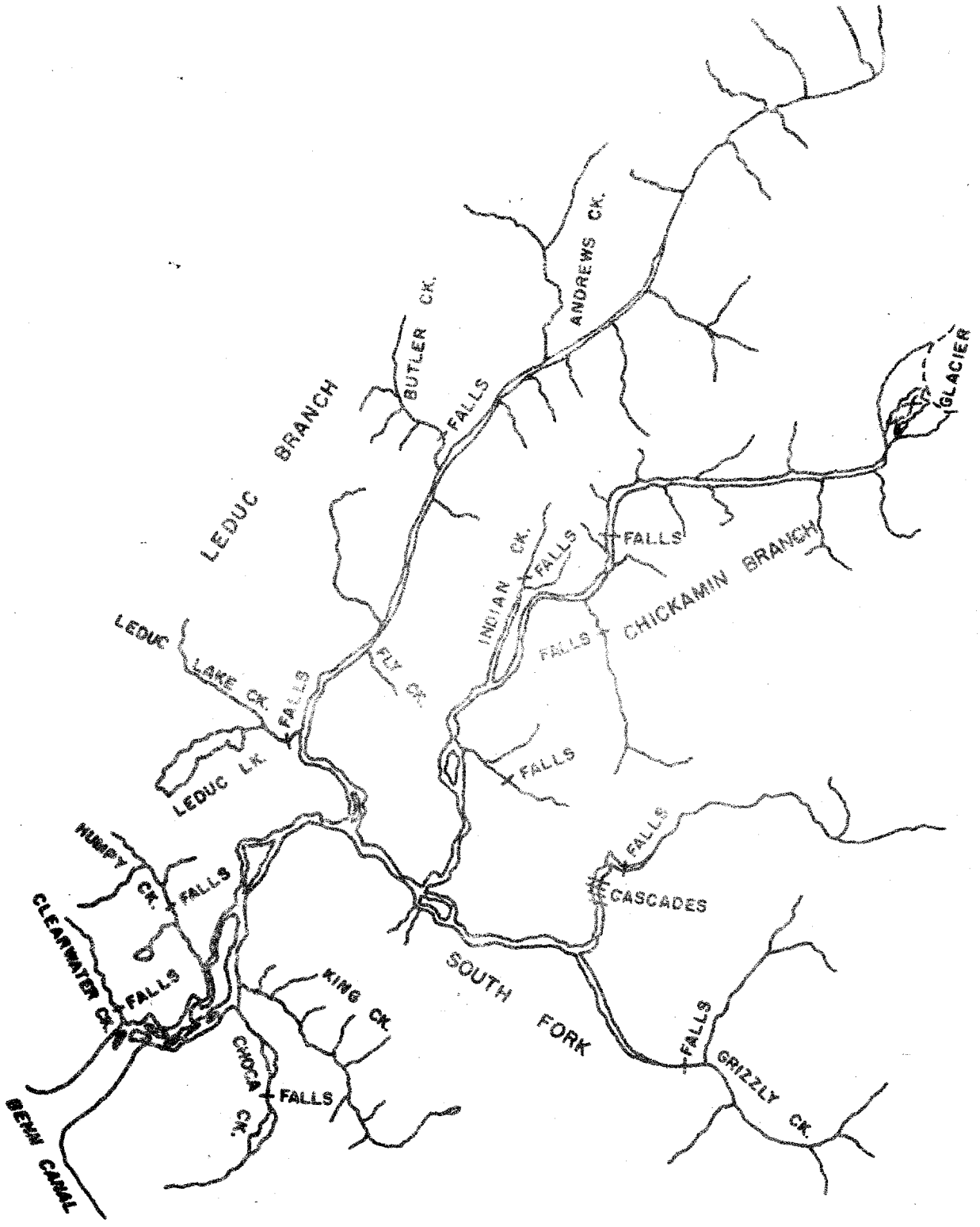

Figure 6. The Chickamin River watershed showing the principal king salmon spawning areas.

and chum salmon, but coho have been observed above this point. A few pinks were observed below the falls.

Humpy Creek

This creek enters a slough of the Chickamin on the northwest shore about 3 miles from the Chickamin mouth. This is the second largest spawning tributary known in the Chickamin River system. It drains a watershed of at least 25 square miles. The creek is 50 to 60 feet wide and about 5 miles long. Riffles in the lower 1-1/2 miles are excellent for spawning while boulders and sandy areas are present in the upper reaches. The stream gradient increases in the upper valley and king salmon inhabited these areas for the most part. Pink salmon were concentrated in the lower 1-1/2 miles. A few king salmon seemed to be quite light in color, indicating their recent migration from salt water. A 6-foot falls at 2-1/2 miles seems to be a block to all species except coho and king salmon. Coho fry were observed in a pool above these falls. Above this point several smaller falls were also present but were passable to salmon. This upstream area was surveyed for about 1/2 mile and found to possess some excellent spawning riffles. No fish, however, were found in this upper section.

Choca (Coho) Creek

This creek enters the Chickamin 3 miles above the mouth on the east shore. It is about 3 miles long and drains a small pond as well as Gilbert Lake. The creek enters a marshy pond 1/4 mile in length as it enters the main Chickamin. The major spawning area is contained in the first 1/4 mile of riffle area above this pond. Here pink salmon were using the area in large numbers. At this point the creek is made up of four channels each about 15 feet wide with excellent spawning gravel. Depth ranges to 12 inches throughout this riffle area. Above this point a series of falls extends for about 3/4 mile to a small pond 1 mile long and 50 to 75 yards wide. It is quite shallow, probably less than 10 feet throughout, with a sandy bottom. Another series of larger falls connects this pond with Gilbert Lake, 1 mile south. The foot survey on August 29 was made only to the lower lake, but on September 1 the system was surveyed by air and all upper tributaries were carefully checked. No fish were seen in the stream emptying into Gilbert Lake or below Gilbert Lake to the smaller pond. In this stretch we saw several falls and a high bedrock slide that appeared to block access to the lake.

Seven kings in all were seen, two in the adjacent areas below the pond, three below the series of falls and two in pools among the falls. A few pink salmon were occasionally seen spawning here also. This area of fast water made fish detection very difficult. Bear predation was restricted to the lower 1/4 mile of the stream.

King Creek

This is probably the most extensive spawning tributary of the Chickamin. It enters the river on the east shore at mile 3-1/2. The stream is over 8 miles long but at mile 6 the stream gradient increases and rapids and small falls halt further migration. The stream averages 40 feet wide and contains excellent spawning gravel throughout the system. The lower reaches are quite sandy but become mixed with gravel and rocks farther upstream. Spawning riffles are nearly continuous beyond the first mile of the lower stream. Some areas at about mile 5 contain gravel too large for spawning purposes. The smaller gravels from mile 2 to mile 4 are used predominantly by pink salmon while the larger gravels above are used by chum and king salmon. Old stream surveys list this stream as the major spawning stream for the latter species. Only a few kings were seen, however.

On September 7, the date of the last survey of the creek, many fresh chum salmon were seen. Pink and king salmon were present that may have recently entered the creek. These fish were concentrated in the lower 2 miles. Above this no live fish were seen.

Bear predation was very heavy on this stream. Four brown bears and one black bear were seen and another heard during the first survey.

Leduc Branch

This is the main branch of the Chickamin River. It is a shallow river for most of its 29-mile length with many channels which are constantly changing, making boating difficult. According to Mr. Wolf a boat can be taken for only 15 miles; our boat survey extended for 13 miles to Butler Creek. In this distance we looked at three creeks; Leduc Lake Creek, Fly Creek and Butler Creek. Several other small mountain streams join the Leduc and may also supply areas for spawning. However, no such areas of spawning were seen. The following is a description of each tributary surveyed.

Leduc Lake Creek

This creek enters the west shore of Leduc Creek 2-1/2 miles upstream from its confluence with the main stem Chickamin. This creek averages 70 feet wide and has 1/8 mile of available spawning area between the Leduc River and a 10-foot falls which may curtail further migration. The substrate is largely boulder, but some areas containing spawning gravels were present in the accessible section.

Fly Creek

Fly Creek empties into the Leduc River from the east bank about 7 miles upriver from the confluence of the Leduc and main Chickamin rivers. This small creek has a steep gradient with about 30 yards of excellent spawning area which averages 10 feet in width. Twenty-five chum salmon were counted here.

Butler Creek

This is a clear stream joining the Leduc 13 miles from the Chickamin on the west shore. It averages 40 feet in width and has about 3/4 mile available for spawning from the Leduc to a 30-foot falls.

Andrews Creek

This creek enters the Leduc River on the northwest shore 17 miles up the Leduc. It has less than a mile available for spawning. It is a glacial stream although a clear slough was noted. This was carefully surveyed from the air and no fish were seen.

Upper Main Leduc

Several small mountain streams enter the Leduc all along the rivers to the Leduc glacier. They are all turbid and of doubtful value for spawning.

Chickamin Branch

This branch is 24 miles long and is similar to the Leduc River in most respects. The lower 10 miles of the branch flows through a narrow, straight valley with a quite definite channel. At mile 14 a series of falls over a mile long may stop upstream migration. An aerial survey revealed that the numerous small streams above this point were all glacial with fairly steep gradients. Three streams were surveyed below this point and are discussed below.

Six Mile Creek

This stream leaves the mountain side via a 30-foot falls and flows 1/2 mile through a marsh overgrown with willows to enter the Chickamin on the east shore 6 miles upriver from the junction of the Chickamin and the South Fork. An unnamed creek that has no gravel available for

spawning joins Six Mile Creek 100 yards before it enters the Chickamin. Only the upper 1/8 mile of Six Mile Creek has gravel suitable for spawning. Here two dead chum salmon, one dead pink salmon and three live chum salmon were seen.

Indian Creek

Indian Creek arises at the head of the lower valley through which the Chickamin flows, descends a 15-foot falls and forms a 50-foot-wide slough for about 2 miles before joining the Chickamin. Some turbid water from the Chickamin mixes with this slough, giving a slight glacial tinge. The slough contains suitable spawning gravel for most of its length. Most of the observed fish were spawned out, but several hundred chum salmon and a few scattered pinks were still alive. Dead fish were caught on every piece of debris and scattered throughout the brush by bears. The count given in Table 3 is of all fish seen living or dead.

Gravel Creek

Gravel Creek enters the Chickamin on the southeast shore 1 mile above Indian Creek. It averages 60 feet wide and is over 5 miles long. It increases in gradient 200 yards from the Chickamin, however, so that no spawning area is available above this point. The creek is very glacial and observations were made with difficulty. One king was seen as his back rose out of water. The bottom composition was of mixed sand and gravel.

South Fork (Barrier Creek)

The South Fork and Entrance Creek meet the Chickamin 13 miles from the Chickamin mouth. The 33 mile long South Fork is glacial, greenish-blue in color, but it is much less turbid than the Chickamin or Leduc Rivers. A 15 to 20-foot falls 9 miles upstream in the South Fork is a complete block to all migration. A short way below this point there is over a mile of steep cascades. Below the cascades to the point where Grizzly Creek enters the South Fork, the water was 2 to 4 feet deep. The stream bottom is made up of large rocks averaging 10 to 20 inches in diameter with many larger boulders and what appeared to be very compacted gravel.

Except for Entrance Creek and Grizzly Creek, the tributary streams of the South Fork contain no spawning areas. There was some evidence that spawning takes place in the main South Fork. Several dead fish were seen on the gravel bars and many gulls were hovering over shallow riffle areas. Two redds were observed in the South Fork 1/4 mile below Grizzly Creek.

Entrance Creek

Two unnamed creeks join several hundred yards from the Chickamin River to form Entrance Creek, a small, clear stream which parallels the South Fork for over 1/4 mile.

Spawning area is restricted to several hundred yards upstream in the two branches which average 15 feet in width and less than 12 inches in depth. Here the gravel averages 1/3 inch in diameter and the gradient becomes quite steep. The lower reaches of both creeks have muddy bottoms and are quite wide and shallow.

Only chum and pink salmon were observed spawning in these small areas.

Grizzly Creek

This clear stream is a major tributary of the South Fork. About 70 feet wide in its main channel, it splits into two 40-foot-wide branches near its entrance into the South Fork, 5-1/2 miles from the Chickamin. The lower branch splits again to form a shore stream which flows about 200 yards across a gravel bar to the South Fork.

Spawning is confined to the lower mile of Grizzly Creek in the forks and small, spring-fed tributaries. Above this point the gradient increases to a series of cascades and the stream bed becomes boulder-strewn and sandy. Two aerial surveys of the entire length of the creek indicated that no spawning area of any size existed upstream. A 15-foot falls at mile 4-1/2 blocks further migration.

Conclusion

The salmon counted in the Chickamin were approximately 7,900 chum, 6,500 pink and 375 king salmon. No red or coho salmon were seen. Stream surveys conducted by John Martin (Fisheries Research Institute, University of Washington) before 1959 list the total escapement magnitude for all species in the three major tributaries, Chocca, King and Humpy Creeks, as exceeding 100,000 fish. We counted less than 2 percent of this number in these streams. Certainly the spawning gravels contained in Humpy and King Creeks could support many more spawners than were present. The number of kings observed was also disappointing. This count may have been reduced by the numbers of unobservable kings residing in the deep pools of King Creek at the time of our survey and by the late survey of Indian Creek, a reported king salmon spawning stream. Mr. Wolf stated several times that "years ago very big runs of king salmon used to enter the Chickamin," apparently this year (1961) was not indicative of the past salmon runs.

TABLE 3. SALMON SURVEY DATA - CHICKAMIN RIVER

SUMMER 1961

River Surveyed	Date Surveyed	Distance Surveyed	Chums	Pinks	Kings	Reds
Chickamin River						
Clearwater Cr.	Aug. 27	1/4 mi.	---	3	---	--
Humpy Creek	Aug. 30	2 mi.	34	825	120	--
Choca Creek	Aug. 29	1 mi.	---	1500	7	--
King Creek	Aug. 4	5 mi.	5000	1500	22	--
	Sept. 7	3 mi.	165	43	48	--
South Fork						
Grizzly Creek	July 8	1/4 mi.	---	---	1	--
	Sept. 6	2 mi.	31	31	36	--
Entrance Creek	July 8	1/2 mi.	---	---	1	--
	Sept. 6	1/2 mi.	150	45	---	--
Chickamin Branch						
Six Mile Creek	Aug. 28	1/2 mi.	5	1	---	--
Indian Creek	Aug. 28	2 mi.	1500	2500	4	--
Gravel Creek	Aug. 28	1/8 mi.	---	---	1	--
Leduc Branch						
Leduc Lake Creek	Aug. 3	1/8 mi.	170	25	42	--
Fly Creek	Aug. 3	30 yds.	25	---	---	--
Butler Creek	Aug. 3	3/4 mi.	15	60	77	--

Southern Behm Canal Area King Salmon Streams

Boca de Quadra King Salmon Streams

Fish counts and dates are listed in Table 4 at the end of this section (page 36).

Martin River

The Martin River at the head of Martin Arm was surveyed for six miles on July 22. Slightly higher water would have provided better boating conditions. Two falls 5 miles upstream, the first 7 feet high, prevented further fish migration. No salmon, not even coho fry, were found above the falls. Resident rainbow trout were present, however.

The stream averages 80 feet in width and contains stretches of both sand and gravel. The river is very clear except for an area about 1 mile long of fast water over large rocks and boulders. King salmon were observed here but white water made the counting of fish difficult and the number of king salmon present have been underestimated. All fish listed were seen in the main river.

Keta River

This river enters the north end of Boca de Quadra. The stream was similar to the Martin, containing stretches of both sand and gravel and averaging 80 feet in length. No fish block was seen in a 5-1/2 mile survey. Twenty-six king salmon were counted upstream and in addition, 18 fresh king salmon were counted coming in on the tide on July 24. This may have been the time of entrance into fresh water. Old stream survey reports list 500 as a maximum king salmon count.

Smeaton Bay King Salmon Streams

Fish counts and dates are listed in Table 4.

Wilson River

The Wilson River drains Wilson Lake and flows 8 miles to Wilson Arm of Smeaton Bay. This clear river averages 80 feet in width. The longest survey conducted in 1961 was 5 miles to a canyon and series of probably passable falls. The stream gradient increases beyond this point, however. The river has a pool-riffle development with some large shallow pools which provide excellent spawning facilities. Fish

were present in the entire length surveyed. Most of the red salmon counted were in the last mile upstream and probably reach the lake to spawn.

Blossom River

The Blossom River was surveyed for 7 miles on Aubust 13. This river joins the Wilson 1/2 mile from its mouth. It averages 80 feet in width with bottom consisting of stretches of both sand and gravel, the latter predominating. Several log jams were present in the river presenting boating difficulties, but in general the river provides excellent boating conditions.

The river was slightly glacial during the surveys and the numbers of fish counted were far less than those in the Wilson River. No fish were seen beyond mile 6, although no fish blocks were present. There are many deep pools in this river where fish cannot be observed but may be present.

TABLE 4. SALMON SURVEY DATA - LOWER BEHM CANAL STREAMS

SUMMER 1961

River Surveyed	Date Surveyed	Distance Surveyed	Chums	Pinks	Kings	Reds
Boca de Quadra						
Martin River	July 22	6 mi.	1200	900	22	--
Keta River	July 24	5 1/2 mi.	3000	300	44	--
Smeaton Bay						
Wilson River	July 7	1 mi.	--	--	--	--
	Aug. 12	5 mi.	650	13,500	63	12
Blossom River	July 7	1 mi.	--	--	--	--
	Aug. 13	7 mi.	215	400	5	--

DISCUSSION

A rough approximation of available spawning area contained in the Unuk River system is 283,191 square yards (58.5 acres). The Chickamin contains about 434,567 square yards (89.8 acres) with Grant, Klahini and Herman Creek supplying another 633,600 square yards (130.9 acres). This makes a total of 1,634,550 square yards (337.7 acres) available for spawning in the North Behm Canal area for king salmon.

These values in square yards of available spawning area were determined from an estimation of width and length of the observed spawning gravels and the summation of the individual spawning units gave a value for the entire system. "Spawning length" was those areas containing proper spawning facilities such as gravel, proper water quality, etc. "Spawning width" was merely the stream width in all cases.

The significance of the available area is more fully realized when gravel type is taken into account. In general, the Chickamin River, Grant Creek and Herman Creek contain excellent spawning gravel. In the Chickamin, King Creek has excellent spawning facilities for 6 miles as does Humpy Creek for the lower 2 miles. The Unuk has much of its available spawning area on the main stem gravel bars or valley floor where mixed sand and gravel forms the stream substrate. The Klahini has many sandy areas in the lower reaches and large boulders nearer the barrier falls.

The above calculations on available gravel indicate that the Unuk River has less king salmon potential than the Chickamin River. The Burroughs Bay gill net fishery of 1954-1956 also supports this conclusion. Table 5 gives the number of kings caught per day for the period indicated. For the years, 1954-1955, an average of 20 and 25 boats, respectively, fished within Burroughs Bay. No data on effort is available for 1956.

TABLE 5. DRIFT GILL NET KING SALMON FISHERY - BURROUGHS BAY, ALASKA (NUMBERS OF KINGS CAUGHT).

Date	1954	1955	1956
July 12-16	782	373	889
July 17-21	427	240	768
July 22-26	160	478	113
July 27-31	242	204	20
August 1-5	54	188	6
August 6-10	23	17	16
August 11-13	2	3	0
TOTAL	1,690	1,503	1,812

It is readily apparent from Table 5 that the Unuk River did not support a large king salmon fishery from 1954 through 1956. Mr. Art Matney, who lived at the Unuk River mouth at the time of this fishery, said that when the nets were fishing no fish whatsoever entered the Eulachon River so that apparently the fishery was very effective in taking the fish that were present. The count of 700 fish in the Unuk system still appears small when compared with these catch records. This is partially due to the fact that the 700 fish is a minimum count and that 1961 was undoubtedly a poor king salmon year. Three tributaries in the Unuk were glacial and fish were present in at least two but not counted because of this turbidity. In Dickens Place Creek only three kings were counted. It is very likely that many more were present, but if fish existed in any great numbers, careful searching would have detected them. Therefore, a safe upper estimate would be 1,500 kings in the system. Excessive main stem spawning would have made this a low count but no evaluation of main stem spawning could justifiably be made.

A comparison of the catch for the years 1953 to 1961 in the Ketchikan area commercial troll fishery showed that 1961 was a poor king salmon year. The statistical areas involved are South Prince of Wales Island (west coast), Clarence Strait, Southern District (from the International Boundary to Ketchikan) and Hecate Strait and Dixon Entrance (International District). The 7 year average (1953-1959) of the number of king salmon caught by troll gear was 110,656 fish. The 1960 total catch for these areas was only 92,204 fish and was even smaller in 1961 with only 71,480 kings landed.

The above values indidicate that in 1961 far less king salmon were taken by trolling than in 1960, which was itself below the previous 7 year average. It is interesting that the only year in the above 7 that had a poorer year than 1960 and was almost as poor as 1961 was in 1956, or 5 years previous to the 1961 escapement. In Southeast Alaska rivers the female king salmon predominantly spawn at the ages of 5 and 6 years old, assuming a seaward migration as yearlings.

The total king salmon counted using the north Behm Canal area for spawning in 1961 was 1,175. This does not include all of the small streams within this area that reportedly contained a few or no king salmon. The count was 375 fish in the Chickamin system, 100 in the other 3 Burroughs Bay streams and 700 in the Unuk River. More attention was given to the larger, more difficult Unuk River and the spawning peaks were missed in perhaps two of the Chickamin tributaries.

Irrespective of numbers of kings counted in 1961, water quality, bottom type and amount of spawning area available indicate a greater king salmon spawning potential in the Chickamin River than the Unuk River.